IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re United States Patent Application of:		**Docket No.:**	**4241-198-CON**
Applicants:	**BARETZ, Bruce, and TISCHLER, Michael A.**	**Conf. No.:**	**2836**
Application No.:	**10/623,198**	**Art Unit:**	**2814**
Date Filed:	**July 18, 2003**	**Examiner:**	**Abul Kalam**
Title:	**SOLID STATE WHITE LIGHT EMITTER AND DISPLAY USING SAME**	**Customer No.:**	**23448**

AFFIDAVIT OF GEORGE R. BRANDES

George R. Brandes, being duly sworn, deposes and says:

1. I hold a PhD degree in physics from Brandeis University, awarded in 1989, and was a Post-doctoral Member of Technical Staff at Bell Laboratories from 1990 to 1992. I am named as an author or co-author in numerous technical journal articles in the field of wide bandgap semiconductors. I have performed research in wide bandgap semiconductors for approximately 18 years, and further managed or directed the research efforts of numerous other scientists in the same field. I am currently a Director at Cree, Inc., which is a leading innovator and manufacturer of semiconductor materials and devices. I am named as an inventor or co-inventor on a large number of U.S. patents, foreign patents, and patent application publications relating to wide bandgap materials, including wide bandgap material-based microelectronic devices and processes, for example, U.S. Patent Nos. 7,390,581; 7,282,744; 7,170,095; 7,118,813; 6,958,093; 6,680,489; 6,641,938; 6,596,079; 6,447,604; 6,329,088; 6,268,229; 6,031,250; 5,973,444; 5,900,301; 5,872,422; 5,680,008; 5,608,283; and U.S. Patent Application Publication Nos. 20080265379; 20080199649; 20080112452; 20070018198; 20060152140; 20060228584; 20050167697; 20050104162; 20050009310; 20030213964; 20040222431; 20030178633; 20030157376; 20020096684; 20020068201; and 20020059898.

2. I have read and am familiar with U.S. Patent Application No. 10/623,198 filed July 18, 2003 in the U.S. Patent and Trademark Office in the names of Bruce Baretz and Michael A. Tischler, claiming the priority of U.S. Patent Application No. 08/621,937 filed March 26, 1996, now issued as U.S. Patent 6,600,175. I have also read and am familiar with the prior prosecution record of such U.S. Patent Application No. 10/623,198, including the October 20, 2008 Office Action and the references cited therein. I am also familiar with the facts and circumstances surrounding the making by Bruce Baretz and Michael A. Tischler of the invention claimed in amended claim 70 of the application, reproduced below,

> 70. A liquid crystal display comprising a back light structure including an LED/phosphor assembly in which the LED is energizable to emit radiation and the phosphor is arranged to be impinged by radiation from the LED so that the LED/phosphor assembly produces white light back light illumination for the liquid crystal display.

and hereafter referred to as the "Invention."

3. I am aware that claim 70 of U.S. Patent Application No. 10/623,198 has been rejected in the October 20, 2008 Office Action under 35 USC 103(a) as unpatentable over Seder US Patent 5,211,467 in view of Stevenson et al. US Patent 3,819,974, that Seder has been cited as teaching a liquid crystal display comprising a backlight structure including a lamp/phosphor assembly, and that the USPTO examiner has contended that it would be obvious to substitute the lamp of Seder in the lamp/phosphor assembly with an LED taught by Stevenson, as "a mere substitution of art recognized equivalents."

4. The Stevenson reference discloses the use of an LED/phosphor device to generate a primary color, and use of an array of such primary color-generating LED/phosphor devices for color displays. The Stevenson teachings are consistent with the conventional approach in the display field at the time the Invention was made, to use an LED emitting red color light, an LED emitting green color light and an LED emitting blue color light, to provide a red LED/green LED/blue LED assembly, as a so-called RGB (red-green-blue) array. Stevenson does not disclose an LED emitting ultraviolet radiation.

5. The Seder reference describes a fluorescent lamp, such as a mercury vapor lamp, emitting ultraviolet radiation at 254 nm, including a gas-filled glass or quartz tube with no phosphors on

the inside surface of the lamp. Reflectors may be employed for directing radiation to the phosphor on an external phosphor diffuser plate, as shown in FIG. 1 of Seder reproduced below, wherein reference number 12 is the gas-filled tube, reference number 14 is a mirror, reference number 24 is a bandpass reflector, reference number 25 is the external phosphor diffuser plate and reference number 26 is phosphor:

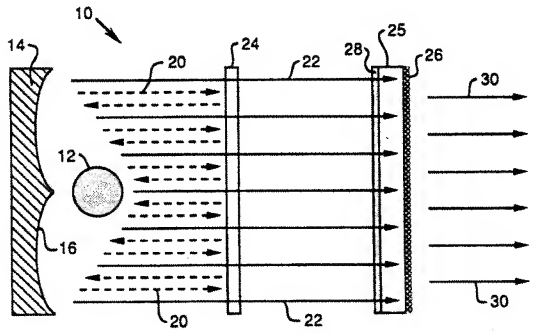


Figure 1

6. The Seder reference also describes an arrangement in which the phosphor is on the mirror, as shown in FIG. 2 of such reference, reproduced below, wherein reference number 42 is phosphor, reference number 44 is the mirror, reference number 48 is a bandpass filter for transmitting white light and reference number 60 is a liquid crystal cell or display:

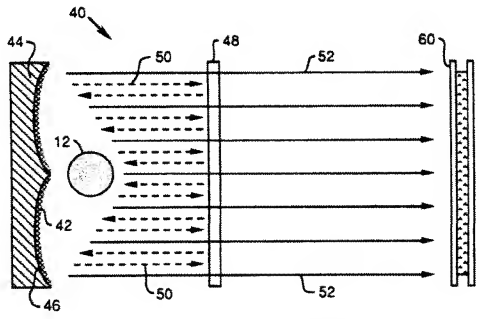


Figure 2

7. The proposal in the October 20, 2008 Office Action to substitute the LED taught by Stevenson for the lamp in the Seder arrangement requires one to disregard Stevenson's teaching to use an LED/phosphor device to generate a primary color, as well as to disregard Stevenson's teaching to use an array of such primary color-generating LED/phosphor devices for color displays. I have been unable to locate any logical basis in the disclosures of the Stevenson and Seder references

for their combination, and any attempt at such combination would require disregard of express teachings in the Stevenson reference, as stated in the preceding sentence.

8. At the time the Invention was made, it was not known that an LED/phosphor assembly could constitute a satisfactory light emitting backlighting device for a liquid crystal display, having sufficient brightness to backlight the LCD screen.

9. In addition to lack of knowledge of suitability as to brightness, it was not known at the time of making the Invention that an LED/phosphor assembly could provide the homogeneity required for backlighting of LCD displays. Backlighting devices for an LCD screen must provide brightness uniformity and color uniformity across the full area of the LCD screen. Any inadequacy or non-uniformity of backlighting can render an LCD display product deficient or even useless for its intended purpose. It was not known at the time of making the Invention that an LED/phosphor assembly could meet these requirements.

10. In addition to the factors noted in paragraphs 8 and 9 of this Affidavit, it was not known at the time the Invention was made whether the extremely long operating life of LED elements (in relation to other then-developed lighting devices) would enable an LED/phosphor assembly to remain stable over such extremely long operating life and provide the high brightness uniformity and high color uniformity required for backlighting of an LCD screen.

11. Based on the facts alleged in paragraphs 7-10 hereof, the Invention has no derivative basis in the teachings of the Stevenson and Seder references.

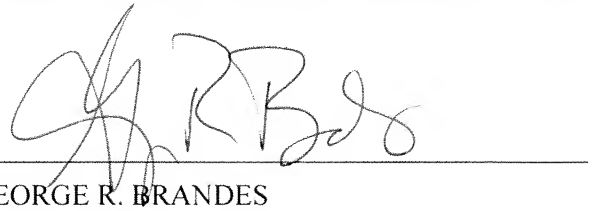
12. At the time the Invention was made, white light-producing single LED devices had not been developed. Appended as Exhibit A of this affidavit is a copy of a copyright 1996 information release of Fraunhofer-Gesellschaft (http://www.thg.de/press/md-e/md1997/197), published after the Invention had been made, stating that "[S]ingle white LEDs were not feasible to date" and that "[T]he mixture of colors making up white light was only possible with a combination of three different diodes." This information release goes on to publicize Fraunhofer-Gesellschaft's "innovative idea ... the generation of white light by luminescence conversion" of an LED/luminescent dye assembly, as a "breakthrough." This information release, after the Invention had already been made, presents the achievement of white light production by an LED (a single LED) in an LED/phosphor assembly as highly innovative. I identify this Fraunhofer-

Gesellschaft information release, after the Invention had already been made by Bruce Baretz and Michael A. Tischler, as further evidence of the innovative character of the Invention as broadly claimed in claim 70 of U.S. Patent Application No. 10/623,198, wherein an "LED/phosphor assembly produces white light back light illumination for the liquid crystal display."

13. Appended as Exhibit B of this affidavit is a copy of an additional information release published in 1997, entitled Fraunhofer-Gesellschaft: Research News Special 1997, published at http://www.fhg.de/press/md-e/md1997/sondert2.htm, which states that:

> "Red, yellow, and yellowgreenish [sic] emitting LEDs have already been on the market for a long time, while blue and green emitting LEDs became commercially available only three years ago. By combining red, green, and blue emitting diodes, the generation of white light became possible. However, the emission of white light by a single chip LED was still impossible.
>
> This problem was solved by a research team at the Fraunhofer-Institut fur Angewandte Festkorperphysik IAF in Freiberg (Germany) and, at the same time, by their colleagues at Nichia Chemical Industries in Japan. Their innovative idea was to generate white light by luminescence conversion. They combined a blue emitting GaN LED with an organic dye or an inorganic phosphor, emitting at longer wavelengths, to synthesise white light by additive colour mixing. ....For the invention of the single chip white emitting LED the research team at the IAF was awarded the 1997 Fraunhofer Prize."

This information release, after the Invention had already been made, (1) identifies the conventional approach of combining separate red, green and blue emitting diodes to generate white light, (2) documents the prior belief in the field that single LED production of white light was "impossible," and (3) presents the achievement of white light production by a single LED in an LED/phosphor assembly as "innovative." I identify this further Fraunhofer-Gesellschaft information release, after the Invention had already been made by Bruce Baretz and Michael A. Tischler, as further evidence of the innovative character of the Invention as broadly claimed in claim 70 of U.S. Patent Application No. 10/623,198, wherein an "LED/phosphor assembly produces white light back light illumination for the liquid crystal display."



GEORGE R. BRANDES

12/12/08

Date

State of North Carolina)
County of Durham)

Before me personally appeared said *George R. Brandes* and acknowledged the foregoing instrument to be his free act and deed this 12th day of December, 2008.

Takako Hayashi
Notary Public Signature

Takako Hayashi
Name of Notary Public

My commission expires: May 11, ~~200~~ 2013 (TH)

SEAL

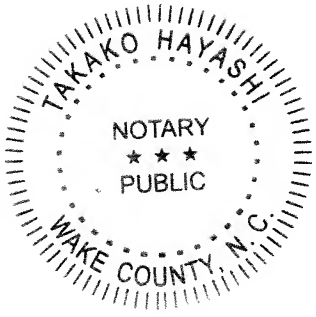


Exhibit A

Topic 1
Dazzling white LEDs

The best products, especially those for everyday use, are small, robust, long-lived and highly efficient. Conventional light bulbs have failed to meet these requirements - being fragile, short-lived, and inefficient. The brighter energy-saving bulbs, however, are oversized and their waste disposal is problematic. Now a new type of white light emitting diode is setting out to conquer the market for illumination.
Light-emitting diodes or LEDs do not contain glowing filaments, since semiconductors convert electrical current directly into light. We encounter LEDs everywhere, for example as yellow, green or red displays in instrument panels. They are long-lived and so especially advantageous, wherever it would be expensive or troublesome to replace short-lived light bulbs regularily.
Single white LEDs were not feasible to date, as they emit monochromatic light only. The mixture of colours making up white light was only possible with a combination of three different diodes. Researchers at the Fraunhofer-Institut für Angewandte Festkörperphysik IAF (Fraunhofer Institute for Applied Solid State Physics) have achieved a breakthrough. The innovative idea was the generation of white light by luminescence conversion. Blue emitting diodes based on gallium nitride were combined with luminescent dyes giving bright light emission at changed wavelengths. The resulting mixture of colours is visible as white light. Furthermore, these LUCOLEDs - luminescence conversion LEDs - allow light emission in a wide colour range, depending on the emission of the dyes used. In addition to white light, arbitrary colour tones of the spectrum are possible, e.g. purple.
The innovative, simple, and inexpensive manufacture of the diodes are excellently suited for large volume production. Siemens will introduce the first white LUCOLEDs commercially next year.

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Exhibit B

Topic 2
White light from a single LED

In contrast to the fragile and shortlived light bulb, lightemitting diodes, or for short LEDs, are small, robust and highly efficient. LEDs are based on semiconductor chips which convert an electric current directly into light. A current of a few milliamps is sufficient to generate light resulting in a low power consumption. LEDs are cheap and have a lifetime of about 100,000 hours, or i.e. they emit light at a constant intensity for 11 years when operated 24 hours a day. Because of these advantages they have already found many applications in, e.g., traffic lights, dashboards and as indicator lights in consumer electronics wherever replacement is cumbersome and expensive. Red, yellow, and yellowgreenish emitting LEDs have already been on the market for a long time, while blue and green emitting LEDs became commercially available only three years ago. By combining red, green, and blue emitting diodes, the generation of white light by LEDs became possible. However, the emission of white light by a single chip LED was still impossible.

This problem was solved by a research team at the Fraunhofer-Institut für Angewandte Festkörperphysik IAF in Freiburg (Germany) and, at the same time, by their colleagues at Nichia Chemical Industries in Japan. Their innovative idea was to generate white light by luminescence conversion. They combined a blue emitting GaN LED with an organic dye or an inorganic phosphor, emitting at longer wavelengths, to synthesise white light by additive colour mixing. Peter Schlotter, a member of the IAF research team, points out a further advantage of the new luminescence conversion LEDs (LUCOLEDs): "LUCOLEDs allow to extend the range of colours emitted by LEDs to whatever colour is required, depending on which conversion dyes or phosphors are used. Even purple light, which is impossible to be generated by conventional LEDs, can be emitted by LUCOLEDs." For the invention of the single chip white emitting LED the research team at the IAF was awarded the 1997 Fraunhofer Prize.

This simple but innovative and lowcost process, developed in close cooperation with Siemens AG, will enable mass production of white emitting LEDs. Siemens plans to start up production of white single chip LEDs in 1998.

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